Quality Manual

SGS Environmental Services, Inc.

5500 Business Drive
Wilmington, NC 28405
(910) 350-1903

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Laboratory General Manager:

Mr. Kendall Sutler — Date: 1/12/09

Technical Director:

Mr. Greg Dickinson — Date: 1-12-2009

Quality Assurance Manager:

Ms. Jeannie Milholland — Date: 1/12/09

(Official copies of final documents will contain all signatures.)

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1. Introduction

The management and staff of SGS Environmental Services (SGS) are committed to providing high-quality, legally defensible data. The purpose of the Quality Manual is to inform our customers of the procedures followed by the laboratory ensuring that all data conform to specific requirements for accuracy, precision, and completeness. The procedures described herein are incorporated into all analyses preformed by the Laboratory. These procedures safeguard sample integrity as well as the reliability and defensibility of the information produced. In addition, client specific quality control measures may be added to satisfy individual client's needs.

The policies and procedures contained in this document have been established in order to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards.

2. Laboratory Organization

2.1. Laboratory Address

SGS Environmental Services
5500 Business Drive
Wilmington, NC 28405
Ph.: 910-350-1903
Fax: 910-350-1557

2.2. Company Officials

David Meyer
Vice President, SGS North America
Ph.: 910-350-1903
Fax: 910-350-1557

Kendall Sutler
General Manager – Wilmington Laboratory
Ph.: 910-350-1903
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2.3. Duties of Laboratory Personnel

The job descriptions and required training for personnel not listed here are contained in the laboratory's training files.

2.3.1. Laboratory General Manager

Directs all laboratory data production operations. Provides oversight of existing laboratory operations, supervises laboratory and pursues new business development. Directs budget and cost controls, financial analysis, and accounting procedures. Manages financial statement preparation. Manages utilization of equipment, facilities, and personnel to obtain maximum efficiency and meet performance objectives. This includes the scheduling and reporting of analytical results. The General Manager (GM) is responsible for ensuring that laboaratory personnel are qualified. The GM is available for consultations with the laboratory staff and clients.

Has a 4 year degree plus 8 or more years relevant experience, or equivalent.

2.3.2. Dioxin Director

Assists the General Manager by performing assignments involved in the planning, organization, and development of complicated projects. Requires ability to use and apply extensive knowledge of all ultratrace tests performed by the laboratory and is authorized to perform final data review.

Has a 4 year degree plus 6 years relevant experience, or equivalent.

2.3.3. Quality Assurance Manager

Directs quality assurance operations for the laboratory. Develops and controls quality programs. Monitors conformance with QA standards and procedures. Conducts quality assurance training for employees. Suggests methods for improving laboratory quality and design. Performs internal audits of the laboratory and a technical review of approximately 10% of data packages. In addition 10% of all DoD data packages will be reviewed. The Quality Manual is maintained current under the responsibility of the Quality Assurance Manager. In his/her absence, a substitute is identified. In his/her absence, the Technical Director has authority.

Has a 4 year degree and 6 years relevant experience, or equivalent.

2.3.4. Technical Director

Oversees laboratory staff and technical operations to ensure accurate and consistent testing procedures and is authorized to perform final data review. Trains, mentors, and evaluates laboratory staff to ensure quality control, safety, and records maintenance. If the technical director is going to be off site for more than 15 consecutive days then a qualified staff member will be designates as technical director in the interim. If the technical director is going to be off site for more than 65 consecutive days then our primary NELAP accrediting authority will be notified in writing.

Has 4 year degree and 6 years relevant experience, or equivalent.

2.3.5. Project Manager

Plans, organizes, and helps control the flow of clients' samples and data to and from our laboratory. Facilitates communication between the lab and its clients, acting in part as a client advocate. Resolves customer complaints. Development of procedures for implementation of specific Statements of Work as required by our clients. Coordinates efforts with other departments and employees to ensures project timelines and budgets are met. Performs a final review of data deliverables before package shipment. Project Mangers are authorized to sign off on final reports.

Has a 4 year degree and 4-6 years relevant experience, or equivalent.

2.3.6. Computer Systems Support Specialist

Provides technical support of computer systems hardware and software. Also provides direct database management, telecommunications maintenance, network administration, and electronic record storage.

2.3.7. Data Reviewer

All data reviewers are responsible for verifying calculations, analyte identifications, and all related QA/QC calculations used in the generation of the sample results. This includes the verification of surrogate spike recoveries, laboratory control sample (LCS) recoveries, precision for sample duplicates and matrix spikes, and results for method and matrix specific blanks. Lab results that are recorded by the analyst onto a data sheet and the associated QA/QC data sheet are reviewed as well. Anyone in the chain of data review has the authority to reject data that they consider in error.

Has 4 year degree and 6 years relevant experience, or equivalent.

2.3.8. Senior Chemist/Analyst

Under the general supervision of a director or manager, is responsible for performing routine analyses and tests. Work requires basic use of scientific methods, procedures, and techniques gained through previous training and experience. Uses basic understanding of theory behind experiments and applies basic analytical skills to implement assigned projects, and to identify and troubleshoot situations needing special attention. In addition, it is the responsibility of the senior chemist to perform the data reduction procedures. These general duties are common to all departments and all analytical methods:

- Following established laboratory QA/QC protocol.
- Recording and maintaining accurate laboratory records including sample identifications, weights or volumes, dilution factors, analysis date and method, analyst's initials, and maintaining the computer record file identification system.
- Performing the proper instrument operation, maintenance, method calibrations and verifying calibration integrity.

- Confirming results of the analytical sequence or batch, including QA/QC verification.
- Converting raw data to final form by applying proper procedures for calculations, rounding, and significant digits.
- Maintaining internal chain-of-custody records, when required.

Four year science degree and three years experience in a related field.

2.3.9. Chemist/Analyst

A Chemist works under the general supervision of a senior chemist. They work to assist with the senior chemists' duties; primarily to identify and quantify analytes of interest while ensuring the accuracy and completeness of raw and calculated data.

Two year degree and four years experience in a related field, or Four year science degree and two years experience in a related field.

2.3.10. Senior Technician

Following routine protocols, under the close supervision of a senior chemist, performs laboratory tests utilizing requisite lab equipment and instruments, making minor adjustments as required. Also is responsible for minor laboratory maintenance, preparing solutions and media, and notification of inventory shortages.

Two year degree and two years experience in a related field, or Four year science degree.

2.3.11. Login Technician

Coordinate sample receipt and the logging of samples into the LIMS system. Produce documentation as to the receipt and condition of samples. Operate and maintain some lab instrumentation, such as pH meter and IR thermometer.

Has a two-year degree.

2.3.12. Preparation Technician

Preparation technicians are responsible for recording accurate data used in final calculations. This includes maintaining extraction and digest logbooks, bench sheets and chemist's notebooks, which contain sample weights or volumes, final extract volumes, surrogate and spike amounts, standard reference numbers, etc.

Two year degree and two years experience in a related field, or Four year science degree.

2.3.13. Technician

The technician assists in laboratory operations under the supervision of a chemist or senior technician. Their duties include recording results from direct readout instruments such as pH meters and thermometers onto a data sheet. Selected wet chemistry parameters require that the technician enter the results into a computer spreadsheet for reduction.

Two year degree or related experience.

2.3.14. Administrative Assistant

Assists project managers with administrative tasks.

Two year degree or related experience.

3. Management Requirements

3.1. Organization

3.1.1. Legal Entity

SGS Environmental Services – Wilmington is appropriately registered for legal process. All (original) business licenses are held by the SGS legal department.

3.1.2. Laboratory Responsibility

The mandate of SGS Environmental Services – Wilmington is to deliver high quality analysis and reporting of environmental samples (including drinking water, wastewater, groundwater, soil, sediment, air, tissue, etc.) in a timely manner in accordance with the requirements of ISO/IEC 17025:2005, and in keeping with the needs of the customer, regulatory authorities and accrediting bodies, including (but not limited to) the National Environmental Laboratory Accreditation Conference.

3.1.3. Scope of Management System

The laboratory management system covers work carried out at SGS Environmental Services – Wilmington. No accredited methods are performed off-site.

3.1.4. Conflict of Interest

SGS Environmental Services – Wilmington is a member of the SGS group – a leading inspection, verification, testing and certification company with more than 40,000 employees and a network of more than 1,000 offices and laboratories around the world.

The core services offered by SGS Global can be divided into three categories:

- **Inspection Services.** SGS inspects and verifies the quantity, weight and quality of traded goods. Inspection typically takes place at the manufacturer's/supplier's premises or at the time of loading or at destination during discharge/off-loading.
- **Testing Services.** SGS tests product quality and performance against various health, safety and regulatory standards. SGS operates state of the art laboratories on or close to customers' premises.
- **Certification Services.** SGS certifies that products, systems or services meet the requirements of standards set by governments, standardization bodies or by SGS customers. SGS also develops and certifies its own standards.

SGS Environmental Services – Wilmington only offers testing services, and is governed by management (as outlined in the organizational chart), which ensures that both real and potential conflicts of interest are prevented. The responsibilities of key personnel (senior management and supervisors) are outlined in the job descriptions (section 2).

All SGS employees are expected to avoid any situation where there is or could be a conflict between their own personal interests and the interests of the organization. It is equally important to avoid the appearance of a conflict of interest.

3.1.5. Laboratory Responsibilities

3.1.5.1. Management and Technical Personnel

The goal of SGS Environmental Services – Wilmington is to provide high-quality, legally defensible data in a timely manner. This can only be realized by fostering excellence in its staff through training and provision of a workplace that is safe, adequately sized, results-oriented, and operates with due regard for the quality management system in place.

SGS Environmental Services has managerial and technical personnel who, irrespective of other duties, have the authority and resources needed to carry out their duties, including the implementation, maintenance and improvement of the management system, and to identify the occurrence of departures from the quality system, and to initiate actions to prevent or minimize such departures.

Job descriptions for management and technical personnel are maintained in the Quality Manual (section 2) and include the above as functions of the respective positions.

3.1.5.2. Undue Pressure

SGS Environmental Services – Wilmington adheres to the Human Resources Management policies laid down by SGS, which helps ensure that management and personnel are free from internal and external commercial, financial and other pressures that might adversely affect the quality of their work.

3.1.5.3. Customer Confidentiality

SGS is committed to protecting the privacy and information of its customers. A copy of our Privacy Notice is made available to all customers, and governs their relationship with SGS. Furthermore, the electronic storage and transmission of results is governed by the SGS Terms & Conditions.

3.1.5.4. Operational Integrity

Integrity is at the core of the business of the SGS Group; it is the common thread through all activities. A Code of Integrity and Professional Conduct has been established to lay down rules of behavior in all dealings for the SGS Group (including SGS Environmental Services – Wilmington) and to provide guidance in day-to-day business. In addition, laboratory procedures have been developed to further support the corporate code.

3.1.5.5. Organization Charts

Organization Charts for SGS Environmental Services – Wilmington are updated regularly, under the direction of the General Manager. Current copies of these are maintained in the laboratory. Information on SGS Global may also be found on the SGS Global website.

3.1.5.6. Responsibility and Authority

SGS Environmental Services – Wilmington operates under the direction of the General Manager, SGS Environmental Services, who is responsible for developing and maintaining the organizational structure, the description of the responsibilities of senior personnel, providing scientific leadership, project planning, ensuring overall timely delivery of project results and overall responsibility for the quality system within the laboratory. The on-site general manager is responsible for balancing the demands of the internal and external customer groups.

3.1.5.7. Laboratory Supervision

SGS provides adequate supervision of all staff as outlined in the Organizational Charts.

3.1.5.8. Technical Management

SGS Environmental Services – Wilmington has a Technical Director and technical support staff that operates under the direction of the General Manager. The Technical Director has overall responsibility for the technical operations and the provision of resources needed to ensure the required quality of lab operations. Technical management is achieved through ongoing communications and weekly operations meetings.

3.1.5.9. Quality Management

The SGS Environmental Services – Wilmington Quality Assurance Manager has the authority and responsibility for ensuring that both the quality and management systems are implemented and followed at all times, with direct access to the General Manager and the Vice President of SGS Env. NAM. The Quality Assurance Manager is independent of laboratory production and reports directly to the General Manager, which is the highest level of management at which laboratory-specific decisions are made.

3.2. Improvement

SGS Environmental Services – Wilmington has a continuous improvement plan in place, within the quality policy and with quality objectives, with inputs from analysis of data, internal and external audits, corrective and preventive actions, and management reviews.

3.3. Corrective Action

Corrective action is initiated whenever a QC failure is identified (e.g., either control limits or holding time has been exceeded). Corrective action procedures generally consist of one of the two following:

3.3.1. Routine Corrective Actions

Most conditions are detected at the initial review level. Documentation of conditions usually takes place on existing forms or in existing logbooks (*e.g.*, a failing calibration will be noted in the instrument run log, a sample halted due to excessive interferences may be noted in the cleanup log.) Many routine conditions, such as calibration outliers, surrogate failure; blank contamination, etc. have pre-determined corrective actions that should be taken. It is the responsibility of the person issuing the corrective action to see that it is completed, usually a Senior Chemist. Consult the corrective action charts presented in SOPs for more details on these routine conditions.

3.3.2. Non-Routine Corrective actions

For conditions without a routine corrective action, such as internal audit findings, PE failures, etc, an investigation is performed by the technical director to determine the cause of the problem. These investigations usually result in a policy or standard operating procedure change. Training by, or under the supervision of the Technical Director on the new procedure must be documented in the training records of those employees affected before the Action is considered closed. A description of the problem, results of the investigation, and the corrective action taken are documented on the Corrective Action Form (Figure 6, for example) by the Technical Director. Completed Corrective Action Forms are reviewed prior to approval by the director or general manager, signed by all parties involved and filed with the Quality Assurance Manager.

3.4. Preventive Action

3.4.1. Action Identification

Needed improvements and potential sources of non-conformances, either technical or concerning the quality system, are identified through the internal audit process.

3.4.2. Action Plans

The Quality Assurance Manager evaluates action plans and, where appropriate, they are implemented and monitored through ongoing verification visits to the affected department. Records of preventive action plans are maintained by the Quality Assurance Manager.

3.5. Performance Audits

Performance audits are conducted bi-annually with the analysis of a PE (Performance Evaluation) sample. PE samples are performed for both soil and water for those tests where a PE standard is available. Analysis results are reported to the PE assay supplier, who in turn issues the acceptance criteria.

In addition, PE samples may be submitted by clients as routine samples.

3.6. Internal Quality Assurance Audits

Internal audits are an essential component of the laboratory's quality assurance system. They ensure that written procedures accurately reflect laboratory practices and that laboratory systems comply with the laboratory's quality objectives, the laboratory's management system, and the requirements of the ISO/IEC 17025:2005 standard. Routine internal audits of laboratory practices are performed annually. Non-routine audits may be performed at the discretion of the QA Manager, at the request of SGS management, or other interested parties. The QA Manager is responsible for performing audits in a timely fashion and accurately reporting the results to management. The QAM is responsible for maintaining files containing audit reports.

3.6.1.1. Non-routine Audits

Non-routine audits may be performed at the discretion of the QAM or upon request from the Technical Director, other SGS management, clients or regulatory agencies. Such audits are generally conducted when quality assurance monitoring indicates a potential problem with some aspect of laboratory performance (e.g. continued low LCS recoveries or poor performance evaluation sample results). Non-routine audits may include the entire laboratory or only a particular section of the laboratory.

3.6.1.2. Audit Checklist

Both routine and non-routine audits are conducted with the use of an audit checklist (See document MI18.) Portions of the checklist may be applicable to individual sections.

3.6.1.3. Audit Procedure

When performing an internal audit, the QA Manager will use the following procedure:

- Pre-audit Meeting: The QA Manager will hold a pre-audit meeting with the Technical Director and the Assistant QA Manager. Other SGS personnel may be asked to attend this meeting. At the meeting, the audit will be scheduled and the overall performance of the laboratory or of the section to be audited will be discussed. The general level of activity within the laboratory may be considered when scheduling the audit; however, it must be performed in a timely fashion. Any relevant information such as quality control data, corrective action reports, or other performance-related information will be discussed. Any assistance required by the QA Manager will also be arranged at this meeting.
- Audit: The audit will be performed by the QA Manager or a designee using the checklist. Not all entries in the checklist are applicable to all sections of the laboratory; therefore, some portions of the checklist may not be used when auditing a particular section. The QA Manager will use all applicable sources of information during the audit. These include the Quality Assurance Plan, Standard Operating Procedures, and interviews with and observations of SGS personnel.
- Order to Halt Work: The QA Manager may issue an order to immediately halt work within a section if he/she determines that ongoing practices in that section will compromise the validity of data produced by the lab. Work within the affected section will stop immediately upon issuance of such an order. The Technical Director and the Laboratory Supervisor will be immediately notified and the Technical Director and the QA Manager will develop a documented corrective action plan. No work will be performed within the section until this plan has been implemented and the QA Manager has determined that the validity of data is no longer compromised. The QA Manager will determine whether any data produced by the lab prior to the audit has been compromised. If so, the affected clients will be notified of this fact and of the potential impact on their data.
- Post-audit Briefing: Upon completion of the audit, the QA Manager will meet with the Technical Director and the Laboratory Supervisor to discuss the audit results. The purpose of this meeting is to quickly review the overall findings and to begin discussion of any potential corrective actions. If necessary, further meetings may be scheduled to develop detailed corrective action plans.
- Corrective Actions: The QA Manager may determine that corrective actions are necessary to comply with documented policy or to ensure continued validity of laboratory data. If this occurs, the QA Manager will work with appropriate laboratory personnel to develop a corrective action plan. Documentation will include the affected practice, corrective action, and a schedule for implementation. The QA Manager will be responsible for monitoring the status of the corrective action plan and insuring that it is completed in a timely fashion. Upon completion of the corrective action plan, the QA Manager will sign off on the documentation.
- Audit Report: Within one week of completion of the audit, the QA Manager will deliver a report to the Technical Director, the General Manager, the Vice President and the analyst. This report will document the audit results, any necessary corrective actions, and the schedule and status of any corrective action plans. If no corrective actions are necessary, the audit file will be considered closed upon issuance of the report. If corrective actions are necessary, the audit file will be considered open until the corrective action plans are completed. The QA Manager will notify the Technical Director and the General Manager upon closing the audit file. Files containing audit

reports will be maintained on site and may be made available upon request to clients, regulatory agencies, and other interested parties.

3.7. External Audits

External Audits are performed by clients and state certification bodies on an on-going basis. Audit reports by state certification bodies are available upon request.

3.8. Reports to Management

On a monthly basis, a report is prepared by the QA Manager that includes SOP status, MDL status, Control Charting status, Audit summaries, Cert issues, PT results, CAR status and any other pertinent information. This report is copied to the QA deputy, Technical Director, General Manager and Vice President. The QA deputy is authorized to prepare the monthly report in the event that the QA Manager is unable to complete the report by the end of the first full week following any given month. On an annual basis, an in depth report is prepared by the QA Manager and Technical Director(s) that includes an account of the suitability of current SOPs, the outcome of internal audits, external audits or evaluations, a summary of major corrective action taken by the laboratory, PE results, client feedback and complaints, changes in the volume or type of work performed by the laboratory.

The laboratory's management shall review the quality system and testing activities report to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. Record storage regarding this report is 5 years.

3.9. Management Review

A review of this quality system is performed once a year by management. A managerial meeting is held to review the quality system. The review takes account of:

- The suitability of policies and procedures
- Reports from managerial and supervisory personnel
- The out come of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- The results of interlaboratory comparisons or proficiency tests
- Changes in the volume and type of work
- Customer feedback
- Complaints
- Recommendations for improvement
- Any other relevant factors

A formal report is written by the QAM to document the meeting's findings and any actions taken. Management ensures these actions are carried out within an appropriate and agreed upon timescale.

3.10. Change in Ownership, Location and Permanent Closure of the Facility

In the event that the facility changes ownership or location, or if the facility is to be permanently closed, the primary NELAC authority and relevant state certifying bodies will be notified in writing. In the event of closure of the facility, clients will be notified in writing so that records may be transferred according to their instructions. All appropriate regulatory and state legal requirements concerning laboratory records will be followed. The laboratory will be accountable and liable for all analyses before and after a change of ownership.

4. Quality Objectives

4.1. Quality Policy Statement

The objective of the quality system and the commitment of management are to consistently provide our customers with data of known and documented quality that meets their requirements. Our policy is to use good professional practices, to maintain quality, to uphold the highest quality of service, and to comply with both the ISO/IEC 17025:2005 standard and the NELAC Standard. Laboratory management

ensures that personnel are free from any commercial, financial, and other undue pressures which might adversely affect the quality of work. This policy is implemented and enforced through the unequivocal commitment of management, at all levels, to the Quality Assurance (QA) principles and practices outlined in this manual, and to the continuous improvement of the laboratory management system. However, the primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

4.2. Quality Assurance Principles

4.2.1. Operation and Calibration of Instrumentation and Support Equipment

4.2.1.1. Instrumentation

Instrument maintenance logbooks are maintained on all instruments. Instrument calibration data is maintained in a file located at each instrument. Instrument manuals and operating instructions are kept in the laboratory with each instrument. Instrumentation that does not have manufacturer's operating instructions has its operation outlined in the appropriate method's SOP.

Proper initial calibration must be performed in accordance with the method specifications for the number, source, and level of calibration standards as well as meet the acceptance limits for linearity. Each initial calibration must be verified at the method specified frequency and recovery limits.

Repeated failure of the calibration verification standard necessitates that sample analysis be stopped, the instrument evaluated, and the initial calibration repeated. Any sample analyzed under failing conditions must be reanalyzed with a new initial calibration.

Analytical instrumentation is calibrated prior to beginning sample analysis. SGS uses the concentrations specified in the Method SOPs to construct an initial calibration. For the exact limits and controls used for a particular method, please refer to its SOP. Some controls and limits used are listed here: A maximum percent relative standard deviation of the response factors from the calibration is specified or a minimum correlation coefficient. The signal to noise ratio for all signals present must be > 10 for some methods while others use a minimum response factor. The ion abundance ratios must be within specified control limits. The concentration of the lowest calibration point may be a modification of the referenced method; in some cases, it is lower than required.

A new initial calibration is required when the continuing calibration criteria below are not met. Routine maintenance may be performed to correct any failures. Any major maintenance to the analytical system such as slit cleaning, analyzer lens cleaning, magnet shifts, and detector disk changes warrant a new ICAL. At a minimum, a new initial calibration must be performed annually.

4.2.1.2. Automatic Pipetting Devices and Syringes

All automatic pipetting devices are cleaned and inspected quarterly. Their calibration is verified and adjusted if necessary. If the recalibration procedure fails, the pipette is taken out of service and replaced.

All syringes are cleaned and inspected annually. Their calibration is verified. Should the syringe fail calibration verification, it is discarded and replaced.

Documentation of these calibration procedures is stored in a calibration logbook. SOP MI46 provides the details of these procedures.

Cat. No.	Volume Range Tested	Accuracy (µl)	Precision (%RSD)
8885-500895	1-10	±0.1 - ±0.1	≤ 9.0 - ≤ 2.0

8885-500929	10-100	±0.5- ±1.0	≤ 1.0 - ≤ 0.4
8885-500945	100-1000	±2.0- ±8.0	≤ 0.5 - ≤ 0.3

4.2.1.3. Fume Hood

On an annual basis, the flow through each fume hood is checked. There is a specified minimum flow rate the fume hood must maintain at a certain sash height. The back panels are inspected and any particulate build up removed prior to the flow check. A sticker is used as an indicator of safe sash height and it is dated to indicate when the hood velocity needs to be rechecked.

4.2.1.4. Balances

Prior to daily use and following malfunctions, balances are checked with three S-class weights and the results compared to tolerance limits. If recalibration is required, the manufacturer's recommendations are followed.

Weight (grams)	Tolerance (grams)
0.1	± 0.02
0.5	± 0.02
1	± 0.02
50	± 0.05
400	± 0.4
1000	± 1.0
4000	± 4.0

On an annual basis, each balance is serviced and calibrated by an outside vendor. Certified reference weights are also calibrated annually by an outside vendor. SOP MI1 contains more information on balance calibration.

4.2.1.5. Thermometers

A thermometer, annually certified by NIST, graduated in at least 0.1°C increments, is used to verify the accuracy of thermometers used throughout the laboratory. The certificate is kept by the Quality Assurance Manager. Standard ice point procedures are followed for most thermometers. Mercury thermometers are calibrated annually and digital thermometers are calibrated quarterly.

Temperature limits	
Refrigerator	Freezer
4-6°C	-10 to -20°C

SOP MI1 contains more information on thermometer calibration.

4.2.2. Performance Parameters

4.2.2.1. Accuracy

Accuracy is the degree of conformity of a measured/calculated quantity to its actual (true) value. Method accuracy is determined from the analysis of a sample matrix spike, laboratory control sample, calibration verification sample, etc. It is expressed as Percent Recovery and is calculated as follows:

$$\%R = \frac{S - U}{C} \times 100$$

where:
%R = percent recovery.
S = Concentration measured in the spike aliquot.
U = Concentration measured in the un-spiked aliquot.
C = Concentration of spike added.

Another formula should be employed for accuracy measurements when a standard reference material is used. For example, a Laboratory Control Spike is not corrected for analyte found in the Laboratory Method Blank, i.e. the blank is not used as the un-spiked aliquot.

$$\%R = \frac{C_m}{C_{rm}} \times 100$$

where:
%R = percent recovery
C_m = measured concentration of standard reference material
C_{rm} = actual concentration of standard reference material

Also, note that for the purposes of accuracy measurement, accuracy expressed as (random) error or bias (nonrandom effects caused by factor(s) unrelated to the analyte) is not used here. For some methods, establishing and correcting for bias is necessary for calibration.

4.2.2.2. Precision

Precision (also called reproducibility or repeatability) is the degree to which replicate measurements or calculations will show the same or similar results. Precision expressed as Relative Percent Difference (RPD) is calculated for laboratory sample duplicates, laboratory control sample duplicates, matrix spike duplicates, etc., as follows:

$$RPD = \frac{(C_1 - C_2)}{\frac{(C_1 + C_2)}{2}} x100$$

where:

RPD = Relative Percent Difference
C1 = Larger of the two values.
C2 = Smaller of the two values.

To compare three or more replicates, precision expressed as Relative Standard Deviation (RSD) is calculated for Matrix Spike Triplicates, Initial Calibration Response Factor requirements, Method Detection Limits studies, etc., as follows:

First, calculate the standard deviation (*s*) of the values to be compared, as follows:

$$s = \sqrt[2]{\frac{\sum_{i=1}^{n}(X - A)^2}{n-1}}$$

where:
n = number of values
X_i; i=1 to n, are the individual values
A = average of the values

Then calculate the RSD as follows:

$$RSD = \frac{s}{A} \times 100$$

where:
s = the standard deviation from above
A = Average of the values

The results of a measurement can be accurate but not precise, precise but not accurate, neither, or both; if a result is both accurate and precise to SOP requirements, it is called valid. Results other than those that are valid may be reported with a narrative note or qualifier (i.e. J flagged values, saturated analytes in low runs, etc.)

4.2.2.3. Completeness

Completeness is defined as the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria required by the prescribed analytical method. The following formula should be used to calculate completeness.

$$\%C = \frac{V}{n} \times 100$$

where:
$\%C$ = percent completeness
V = number of measurements judged valid
n = total number of measurements necessary to achieve a specified statistical level of confidence in decision making.

The completeness goal is to achieve 95% completeness on our first analysis. Subsequently, our goal is to achieve 100% completeness by reanalysis.

4.2.2.4. Representativeness

Representativeness can help to ensure that a set of data accurately depicts the distinguishing characteristics of the sample source. The laboratory will follow guidelines in this document to obtain a representative sub-sample.

4.2.2.5. Comparability

Consistency in the preparation and analysis of samples is necessary so the results may be compared with regulatory requirements. Results will be reported in a manner consistent with good laboratory practices. Standard EPA analytical methods and quality control will be used to support the comparability of analytical results with those obtained in other testing. Calibrations will be performed in accordance with method or manufacturer's specifications and will be checked with the frequency specified in the SOPs. Our goal is to consistently achieve a performance level in terms of accuracy and precision for sample parameters in similar matrices.

4.2.3. Demonstration of Capability

For a given analytical methodology and matrix, each analyst performs an initial demonstration of capability (IDOC). Four replicate samples are fortified with analyte at levels corresponding to the method's requirements. Satisfactory performance criteria are established prior to the analysis (Figure 1).

On an annual basis, each analyst must demonstrate on-going acceptable performance with the successful analysis of a blind sample, the use of four consecutive Laboratory Control Samples to meet the initial demonstration of capabilities acceptance limits or by repeating the initial demonstration of capability.

4.2.4. Determination of Method Detection Limits

On an annual basis, or whenever significant modifications are made to the methodology, the laboratory shall determine method detection limits for each preparatory-determinative method on each applicable instrument. The Method Detection Limit (MDL) is calculated following the analysis of seven replicate samples fortified at levels within a factor of five of the measured MDL (40 CFR Part 136, Appendix B; EPA Test Methods EPA-600/4-82-057). SGS SOP DC180 outlines the MDL procedure. MDL data is for information only and is not used during the reporting of actual sample results unless requested. The following requirements must be met for reporting data to the DoD. These criteria will be evaluated for all methods for which the laboratory holds DoD certification.

The appropriateness of the analyte concentrations should be evaluated based on the ratio between the mean recovered concentration and the calculated MDL. The ratio should be between 1 and 5 for waters, and between 1 and 10 for other matrices. If the ratio is outside the acceptable range for any target analyte, the spike concentration should be adjusted and the MDL study repeated. The MDL is required to be <1/3 the method reporting limit.

To ensure that valid MDL values are determined, the laboratory shall analyze an MDL check sample by spiking an interference-free matrix with all target analytes at about two times the calculated MDL. This MDL check sample shall be taken through all the same

4.2.5. Reporting Limits and Sample-Specific Detection Limits

The normal reported detection limit is the Practical Quantification Limit (PQL). PQL reflects the lowest concentration used in the associated initial calibration curve. Reporting below the PQL to the MDL is available on request. Any concentration reported between the PQL and the MDL is flagged as an estimated value.

For method 1613, the sample summary datasheet displays reporting limits based on the lowest calibration point as defined in the method. Concentrations of detected analytes are not reported below these limits.

For methods 8290, 23, TO-9A, 8280 and 1668A, the sample summary datasheet displays the concentration of any detected analytes as well as a sample-specific detection limit for each analyte. The detection limit is calculated based on a response equivalent to 2.5 times the background noise in the two monitored ions and is known as an Estimated Detection Limit (EDL).

For samples related to the USACE, the lowest detection limit for non-detects must be no lower than the calculated MDL (i.e. the EDL is not used.)

4.2.6. Education/Training

Qualifications of the staff are a key element of acceptable laboratory performance. All training is documented in the employees' Training Records. Training begins with an overview of the laboratory operations with an emphasis on the interdependencies of the various functions and their role in providing a quality service.

New employees are required to read the Quality Manual, Health and Safety Plan, Code of Conduct, relevant SOPs and reference Methods before beginning work. A signed copy of the Code of Conduct statement is stored in the employee's training records.

Further training will cover each method and our corresponding SOP and other topics such as instrument maintenance, manual integration practices, et.al, relative to the trainee's job description.

Training classes are followed by a hands-on approach with experienced and senior chemists. Further details regarding training procedures can be found in our specific SOP.

4.2.6.1. Confidentiality and Proprietary Rights

SGS considers all client and sample related information to be confidential. At no time will the laboratory disclose confidential or proprietary information, including matters of national security.

Employees will not, directly or indirectly, disclose confidential or proprietary information of either SGS or its clients.

4.2.6.2. Employee Ethical and Legal Responsibilities

All employees must attend a seminar that describes the following policy: Employees will employ good scientific judgment and will not make false entries or misrepresent data, dates, calculations, results or conclusions. Employees will avoid situations that involve a conflict of interest. Employees will not participate in any outside activity that results in commercial, financial or other pressures that adversely affect the quality of their work. The violation of these codes will result in disciplinary action up to and including termination of employment and referral for civil or criminal prosecution where appropriate.

Employees are required to attend ethics training as part of their initial training program, and annually thereafter. Signed documentation is kept in the employees' training files.

4.2.7. Standard Operating Procedures

SGS maintains standard operating procedures (SOPs) that accurately delineate all phases of the laboratory processes. SOPs are categorized and codified. Updated versions are implemented via LIMS control and the old version archived. The effective date of each SOP is clearly indicated. Originals (with signatures of the approving authority) are stored with the QA Manager; controlled copies of SOPs are accessible to all personnel.

SOP's are developed and implemented for key steps and procedures used by the laboratory in the course of analyzing samples. Management is responsible for the development, distribution/dissemination, communication and update of the SOPs. All SOPs are reviewed annually at a minimum, and revised as necessary.

4.2.8. Reference Materials and Standards

Reference materials and standards are purchased commercially from a provider that can provide traceability to national standard of measurement (i.e. NIST). Source material selection criteria also include reagent purity (99%+ when available.)

Documentation is kept for the purchase, receipt, and storage of materials and standards. Documentation for items purchased pre-prepared, ready-to-use shall include manufacturer, lot number, type and amount received, concentration/purity, date of receipt, opened date, expiration date and the certificate of analysis. Documentation for media prepared in the laboratory shall include date of preparation, preparer's initials, type and amount prepared, concentration/purity, manufacturer and lot number, and expiration date. All media prepared in the laboratory is documented in the Supplies Preparation Logbook.

Reference standards are stored in the individual department laboratories. The extraction, semi-volatile organic, and volatile organic departments have refrigerators which are dedicated to standards. Samples and standards are never stored in the same refrigerator. Standards for organic methods are stored in borosilicate glass containers with a Teflon lined cap, which have been cleaned and solvent rinsed. Standards of compounds that easily precipitate or have a high affinity for solids are stored at room temperature (i.e. Dioxins, Furans, Terphenyl.) Metals standards are stored at room temperature and placed in a storage cabinet. Storage of standards used in atomic absorption analyses should be in a polyethylene container, except where noted in the method, i.e., silver. Standards that have expired must be immediately removed from the storage unit and taken to the waste disposal area.

Labeling of calibration and quality control standards should contain the following minimum content: Standard name, concentration and units, initials of preparer, date prepared, expiration date, and Standard number (unique logbook reference).

Procedures for the preparation of standards are found in the analytical method SOPs.

4.2.8.1. Expiration Dates for Ultratrace Standards

- Primary Standard Solutions (ampoule from commercial source): Use the manufacturer's date. If a stability study is in progress, use 5 years.
- Stock Standard Solutions (obtained from dilution/mixing Primary Standard Solutions): Up to 1 year, not to exceed the Primary Standard expiration date.
- Working Standard Solutions (from Stock/Primary and used during sample processing): Up to 30 days, not to exceed the Stock Standard expiration date.

Note that all solutions prepared by SGS with a nominal concentration of less than 0.1 ng/uL are assigned a 30-day expiration time.

4.2.8.2. Expiration Dates for Volatiles Standards

- Working standards from stock mixes are replaced every month or sooner if suspect. Stock standards prepared from neat are replaced every six months or sooner if suspect. Gas standards are replaced weekly.
- Unopened ampulated standards and neat chemicals have an expiration date specified by the manufacturer, not to exceed 5 years.

4.2.8.3. Expiration Dates for Metals Standards

- Single element stock standards >1,000 mg/L are good for 18 months from date of manufacture.
- Tuning Solutions > 10µg/L are good for 12 months from the date of manufacture.
- Multi-element Calibration Stock Solutions at 20mg/L are good for 6 months from preparation.
- Multi-element Calibration Working Solutions >200 ug/L are prepared fresh when performing a cross-calibration.
- Internal standard solutions at 2.5 mg/L are prepared fresh as needed.
- Calibration stock standards at- 1-100 mg/L are good for two months.
- Calibration stock standards at 0.1-1000 µg/L are good for 7 days.
- Interference check stock standard at 500 mg/L is good for two months.
- Interference check working standards are prepared fresh weekly.
- Quality control stock standards are good for one year from date of manufacture.
- Quality control working standards are good for 7 days.

4.2.9. Isotopically Labeled Standards

All procedures intended for the determination of PCDD/Fs or PCBs call for the use of a series of isotopically labeled congeners. These compounds are used to monitor the extraction and fractionation efficiencies as well as for the qualitative and quantitative characterization of the target analytes. SGS uses labeled compounds with the highest level of purity obtainable from commercial sources. Records pertaining to the acquisition and preparation of the standards are kept inside a dedicated, page-numbered logbook. Information such as the manufacturer's name, lot number, date received, percent purity, name of the chemical or mixture of chemicals, concentrations and manufacturer's QC data is recorded. Section 2 of the SOPs describes the procedures regarding receipt and preparation of standards.

4.2.10. Supplies, Reagents and Consumable Materials

Procurement of supplies and services for SGS Environmental Services – Wilmington is governed by strict purchasing policies, laid down by the SGS Corporation. All purchases require approval from management (or their designated backup) to ensure that the supplies or equipment purchased are of adequate quality to sustain confidence in the analytical test. Preference is given to suppliers with ISO certification or accreditation and the use of materials that are traceable to international standards. Records of approved suppliers are maintained by the purchasing department.

Upon receipt of all purchased items for the laboratory, part numbers are checked against the purchase order. All materials traceable to a national standard are checked to ensure they have a certificate of analysis and/or production information. In the event that appropriate documentation is not provided, the purchasing department is notified and the supplier is contacted for immediate replacement and/or submission of all required documentation. The laboratory will ensure that all purchased supplies, reagents and consumable materials that affect the quality of environmental tests are not used until they have been inspected or verified as complying with requirements specified in each test method. Records documenting verification are maintained in a dedicated logbook.

4.2.11. Performance Evaluation Samples

Performance evaluation samples are generally submitted with compliance samples (e.g., Method 23) or as part of a certification process (e.g., SDWA Method 1613). Standard Reference Material (SRM) samples are analyzed and reported upon request (tissue, soil, etc.).

4.2.12. Participation in inter-lab and intra-lab studies

It is the policy of SGS to participate in inter-lab and intra-lab studies with clearly defined and functional objectives.

4.2.13. Review of New Work

Before any new work is accepted or pursued, a Project Manager (PM) must take into consideration the area within our lab that will be impacted. The PM then assesses that area's capacity to perform the new work along with its current duties so as not to adversely affect quality. The availability of instrumentation,

personnel, and other resources must be sufficient before commencing such work. The required quality objectives of the project will also be evaluated in order to assess laboratory capability.

4.2.14. Preventive Maintenance

Laboratory equipment (i.e., GC, MS, balances, and vacuum pumps) is subject to regularly scheduled preventive maintenance (PM). SGS holds service contracts with the manufacturers of the High-Resolution Mass spectrometers, the metals OES instrument, and a volatile purge and trap system. All contracts include preventive maintenance. Documentation of PM performance is recorded inside maintenance logbooks. Maintenance records contain the date of each instrument's installation, the date and a description of the repairs or maintenance, modifications, and the initials of the chemist/engineer performing the tasks. Major equipment maintenance requires the use of signage to designate the instrument out-of-service. All analytical instrumentation is serviced by an external instrumentation service vendor or by SGS personnel trained in preventive maintenance. All instrument preventive maintenance is performed according to the manufacturer's recommended procedures. SOPs address more specific preventive maintenance procedures. A current list of major laboratory equipment and instrumentation may be found in Figure 8.

4.2.15. Documentation Control

All standard operating procedures, manuals, and documents used in the quality system are controlled and maintained. Document control procedures are found in SOP #DC49. Each document has a unique identifier that can be found in the Document Control Index. These procedures ensure that all documentation clearly indicates the period of time during which it was in force and that the proper steps were taken for archiving the previous revisions. Documents may not be amended by hand pending the re-issue of new, controlled documents. All controlled documents must be reviewed at least annually for accuracy and adequacy, and updated as appropriate.

4.3. Quality Control

4.3.1. Analytical Methods

A very important element of the SGS quality system is strict adherence to standard analytical methods. SGS uses appropriate methods and procedures for all tests within its scope. Deviations from the test method are allowed only when the deviation has been documented, technically justified, authorized and accepted by the customer. The quality control samples described below are designed to meet requirements of the specific analytical method being used. Refer to individual method SOPs and specific methods for quality control requirements.

In the event that SGS should have the need to develop a method for its own use, the activity will be planned, outlined and documented, and assigned to qualified personnel equipped with adequate resources. Plans will be updated as method development proceeds while maintaining effective communication amongst all personnel involved. Method development falls under the supervision of the Technical Director, and the Technical Director will maintain all appropriate documentation.

SGS will validate laboratory-developed methods, non-standard methods and modifications of standard methods to confirm that these methods are fit for the intended use. Procedures and results will be recorded, and a statement released as to whether the method is fit for the intended use.

4.3.2. Generation of Representative Sub-Samples

Water samples must be inverted several times until homogenized. Particulates must be incorporated and evenly distributed. Never split a non-homogeneous sample. Any sample that contains greater than 1% solids is subject to dual extraction. Before proceeding, contact a Project Manager to discuss this requirement with the client (some clients may choose to ignore the solids and decant the sample.)

Solid (soil, etc.) samples, not used for volatiles analysis, are homogenized by stirring the entire sample in its container if there is sufficient room in the container and the sample is free flowing or moist. Never split a non-homogenous sample. Samples requiring particle size reduction should be emptied into a beaker or onto foil for homogenization. Extraneous materials such as rocks, twigs, or vegetation should be noted on the extraction sheet and removed from the sample. Samples requiring volatiles analysis are

not subjected to homogenization. Care is taken to remove soil aliquots from the core of the sample for volatiles.

Note: Care must be taken when non-indigenous soils are handled. One must place foil down over the workspace to catch any spills. This foil and any items used in contact with the soil must be packed and properly labeled with purple stickers to insure proper disposal.

Prior to processing tissue samples, it must be determined as to the exact tissue that is to be analyzed. Analytical requests include whole fish, whole fish less skin, fillets, specific organs, or various portions of the above. When practical, samples are ground and homogenized while frozen. Once reduced in size, process the tissue through a meat grinder or tissue macerator and collect into a suitable container.

If a sample cannot be homogenized by these means, record observations and contact a Project Manager for a discussion with the client as to the steps to be taken.

4.3.3. Preparation Batches

A preparation batch is a group of twenty or less samples of the same matrix type that are prepared for analysis by a unique analytical procedure (SOP). A preparation batch employs the same analysts, equipment, method (SOP), cleanup, and concentration procedures. Each preparation batch has associated with it the appropriate quality control samples required by the method and usually includes the laboratory method blank (LMB, preparation blank), the laboratory control sample (LCS), LCS duplicate (for some methods), matrix spike, and sample duplicate or matrix spike duplicate. Each preparation batch is assigned a unique batch number for easy reference and tracking.

4.3.4. Analytical Batches

An analytical batch refers to a group of samples analyzed by a specific analytical method, technique, or instrument. The analytical batch can include samples from multiple preparation batches; however analysts are trained to group preparation batches into as few analytical batches as necessary. They include samples that are analyzed together within the same period of time (usually within 12 hours) by the same instrument quality control samples such as GC/MS tunes, instrument blanks, initial calibrations, and/or continuing calibration verifications. Each analytical batch is assigned a unique batch number for easy reference and tracking.

4.3.5. Laboratory Method Blank

A laboratory method blank (LMB), or preparation blank, is analyzed with each batch as a check on system contamination. A method blank consists of a surrogate matrix that is processed like a sample. Generally, a soil matrix is replaced by sodium sulfate and/or sand, an aqueous matrix by reagent water, and biological tissues by vegetable oil.

As a quality control sample, the results are used in conjunction with other control data to validate overall system performance and data quality. The criteria for an acceptable LMB are as follows:

- Recoveries of the surrogate (i.e. extraction standards) must be within the specification of the method,
- Sample-specific detection limits must be below the Reporting Limit, and
- No target analytes may be detected at concentrations exceeding the lower method Calibration Limit (or Minimum Level for Method 1613), or 10% of the sample result, whichever is greater.
- For DoD samples, LMB contamination must be less than one half the reporting limit, for methods which do not have method specific blank requirements. Samples that are non-detect may be reported on a contaminated blank.

A LMB that does not meet these criteria requires a re-extraction and/or re-analysis of the associated samples.

Regarding method 1668A, certain PCB congeners are difficult to remove from the laboratory environment. If levels of PCBs in the LMB are detected above the Reporting Limit (RL) listed in Table 2 of EPA Method 1668A, the data may be qualified and reported.

4.3.6. Laboratory Control Samples

The laboratory control sample (LCS, also known as an Ongoing Precision & Recovery Sample (OPR)) is used to assess the general performance of the analytical procedure. The LCS is a quality control sample, similar in composition to the method blank, but spiked with the analytes of concern at a known

concentration. It is processed through the entire analytical procedure. The purpose of these samples is to assess the accuracy of the procedure in the absence of matrix interference. This accuracy is compared to limits specified as a means of controlling the quality of the data produced. It is standard policy to include as many analytes as possible in the LCS spike mixture; this normally involves most of the common target analytes. When the spike list is extensive, there exists a high probability of having a few analytes outside the acceptance limits. These issues are addressed on an individual basis.

A LCS Duplicate (LCSD or OPRD) sample is processed as well for some methods (e.g. Ultratrace) and used to assess the precision of this procedure in the absence of matrix interference.

4.3.7. Matrix Spikes

Matrix Spikes (MS) are analyzed with each batch of up to 20 samples of a similar matrix. They consist of a field sample that is spiked with the same analytes as the LCS and normally at the same concentration. The matrix spike is used to assess the performance of the method in real sample matrices.

4.3.8. Duplicates and Matrix Spike Duplicates

Duplicate samples or matrix spike duplicates (MSD) are extracted or analyzed with each batch to monitor method precision in sample matrix. For analytical methods for which spiking is inappropriate, sample duplicates are used to assess precision.

4.3.9. Laboratory QC Sample Acceptance Criteria

Each test has acceptance criteria for blanks, LCS, MS and MSD.

All data is evaluated by the analyst for compliance with test specific QC objectives. Out of QC control data will be addressed by one or more of the following options:

- Re-extraction and/or re-analysis of sample
- Discussion and qualification of data by case narrative
- Client notification
- Re-sampling and reanalysis (client decision)

Out of control QC data may be reported if directed by the client if it is qualified by a case narrative detailing the QC problems with a statement on the usability of the data.

4.3.10. Blind Performance Evaluation Samples

Performance evaluation samples (PES) are analyzed twice annually. The results of these tests are monitored by the QA Manager. Copies are available upon request. PES are for both water and soil and come from a NELAP approved vendor.

4.3.11. Statistical Analysis Tools & Control Charts

Quality control charts are designed to detect trends and deviations from normal performance. A variety of charts, including LMB and OPR results, are developed and analyzed on a regular basis, usually annually or when requested by clients, to ensure adequate system performance. Charts are monitored for individual points that are outside the control limits (outliers), multiple points above or below average (mean shift), several consecutive points increasing or decreasing (ramping), etc. SGS SOP DC183 outlines the procedure used for control chart generation.

Whenever possible, lower and upper control and warning limits are defined to help with the management of laboratory operations. Such information can be reviewed as part of a laboratory audit or requested as part of the deliverables (USACE).

4.3.12. Certifications

SGS currently holds certifications in Alaska, Arkansas, California, Connecticut, Florida (NELAC-primary), Georgia, Kansas, Kentucky, Louisiana (NELAC-secondary), Maryland, Massachusetts, Michigan, Navy, Nevada, New Jersey (NELAC-secondary), New York (NELAC-secondary), North Carolina, Oregon, South Carolina, Texas, Utah, Virginia, Washington, West Virginia and Wisconsin. For a current list of certifications, please contact the laboratory.

5. Laboratory Operations

5.1. Sample Receipt & Tracking

Upon receipt, samples are examined with regard to the Sample Acceptance Policy (Figure 2). Please contact the laboratory for any question regarding the sample acceptance policy, i.e. types of containers, preservation, etc. The accompanying chain-of-custody (COC, Figure 3) records are signed, dated, and the time is noted. The integrity of the custody seals is assessed and documented. The contents of the sample labels are verified against the chain-of-custody and discrepancies are noted on the Sample Receipt Checklist (SRC, Figure 4). The temperature is taken using an IR thermometer and is documented on the chain-of-custody. If any sample shows signs of damage upon receipt or if there are any discrepancies between the chain of custody and the actual containers received, the Project Manager is immediately notified and the client contacted. Any changes or corrections requested by the client are documented on the chain of custody.

Each Sample Delivery Group (SDG) is entered into a database via the Laboratory Information Management System (LIMS) and is assigned a sequential and unique project number (i.e., G301-1), sample number, and container ID. The LIMS prints a series of labels containing both the Client Sample ID and the Laboratory Sample ID. These labels, which are used throughout the entire sample handling process, are designed to eliminate the risk of sample switching and to maintain sample integrity. If the project requires, as requested by the client, that a chain-of-custody be maintained within the laboratory, then internal chain-of-custody forms (ICOCs) are generated at this time by the LIMS prior to sample storage.

Following a review of the information recorded at the sample login stage, a sample receipt acknowledgement is delivered by fax or email to clients who request this information.

5.2. Sample Storage and Disposal

Samples are stored in a refrigerator kept at 4 ± 2°C for a period of 30 days after the completion of the project (Note that NC DEM requires 1.1-4.4°C). Other arrangements are possible when specified by the client. Tissue samples are stored in a freezer maintained at -10 to -20°C. The temperatures are recorded daily. Sample extracts are retained at room temperature for up to six months after the final report is issued. If necessary, other arrangements can be made at the beginning of the project.

Wastes from various processes within the laboratory must be separated based on matrix type and then disposed of properly. All laboratory waste (solvents, reagents, standards, and samples) is routed through a waste disposal company in accordance with state and federal regulations.

5.3. Sample Subcontracting/Shipping

For certain projects, it may be necessary for SGS to subcontract some analyses. Samples to be analyzed will be shipped to the contracted laboratory using the SGS sample kit. To prevent sample breakage, only EPA-approved sample containers will be used. Foam packing material and wet ice will be used to prevent breakage and to maintain the temperature of the samples. A chain of custody will also be included. Samples will either be delivered by hand to the subcontract laboratory or shipped via Federal Express using priority overnight service. A copy of the chain of custody and the tracking number will then be put into the project folder.

Subcontract laboratories receiving DoD samples must have an established and documented quality system that complies with DoD QSM requirements, be approved by the specific DoD component laboratory approval process, and receive project-specific approval from the DoD client prior to sample analysis.

5.4. Holding Times

Holding times are measured from the date of sampling to the date of extraction. Maximum holding times for the methods commonly performed at SGS are listed in Figure 5. Analyses that exceed holding times may require re-sampling and re-analysis if the associated data will be used for regulatory purposes.

5.5. Sample Conditioning

The purpose of the conditioning step is to prepare the sample for extraction or generate information to be used for the extraction and reporting steps. Thus, homogenization, filtration, drying, determination of the percent moisture or lipids, weighing, measuring the pH and volume of aqueous samples, dissolution, and fortification of the sample are considered as part of the sample conditioning. All data is recorded in the LIMS via a computer located in the sample conditioning area.

5.6. Sample Isotope Fortification

For Ultratrace Methods, there are three steps during sample handling that require the addition of a known quantity of labeled PCDD/Fs or PCBs.

The extraction is preceded by the introduction of a number of carbon-13 labeled analytes, known as "Extraction Standards (ES)", directly into the sample matrix. (Referred to as "internal standards" in Methods 8290 and 23, and "labeled standards" in Method 1613.)

SGS refers to the group of five labeled 2,3,7,8-substituted PCDD/Fs added to air sampling devices prior to sampling as "Sampling Standards (SS)". The same group of labeled compounds is used as "Cleanup Standards (CS)" in the SGS version of Method 8290. Method 1613 requires a cleanup standard consisting of one labeled compound, and Method 1668A uses three labeled compounds. Cleanup standards are added to the sample immediately after extraction.

Finally, the labeled compounds added to the final sample extract before injection into the GC/MS system are called "Injection Standards (JS)". (Referred to as "recovery standards" in Methods 8290 and 23, and "internal standards" in Method 1613.)

5.7. Sample Extraction/Fractionation/Analysis

Sample extraction, fractionation and analysis are based on USEPA methodologies. Depending on the type of matrix and EPA methodology, SGS follows validated procedures that meet or exceed the methods' requirements. These procedures are detailed in method SOPs.

5.8. Analytical Procedures

SGS provides analyses for a wide range of organic and inorganic environmental contaminants. Methods include:

1030 Ignitability
1311 TCLP
4500 H+ pH
300.0 Nitrite
300.0 Fluoride
300.0 Nitrate
504.1 EDB/DBCP
601 Volatiles
6010 ICP Metals
602 Volatiles
6020 ICPMS Metals
624 Volatiles
625 Semi-volatiles
7196 Chromium VI
7471 Mercury
8011 EDB/DBCP
5035 Volatile Prep
5030 Volatile Prep
8270SIMS Semi-Volatiles
8015 DRO
8015 GRO
8015 Methanol
8021 Volatiles
8081 Pesticides
8082 PCBs
8151 Herbicides
8260 Volatiles
8270 Semi-volatiles
8310 PAHs
8315 Extractable Organics
9040 Corrosivity
9045 pH
MA-EPH Extractable Organics
MA-VPH Volatile Organics
SM 6230D Volatiles
AK101 – GRO
AK102/103 DRO
200.7 ICP Metals

9060A TOC	9095 Paintfilter
7470 Mercury	245.1 Mercury
3030C Acid Extraction	3010 Aqueous Digestion
3050 Solid Digestion	SM3500 Fe Ferrous Iron
300.0 Chloride	300.0 Sulfate
4500 Cl Chloride	4500 NO2 Nitrite
4500 NO3 Nitrate	4500 SO4 Sulfate
8141 Pesticides	3580 Waste Dilution
3541 Soil Extraction	3520 Liquid/Liquid Extraction
4500 CO2	

SGS's Ultra-Trace Analyses section provides analyses for polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs), polybrominated diphenyl ethers (PBDEs), and polychlorinated biphenyl congeners (PCBs) using a combination of isotope-dilution high-resolution gas chromatography and both high-resolution and low-resolution mass spectrometry. Methods include:

Method 23 for stationary sources of combustion (Clean Air Act)
Method 8290 for soil/sediment/water/tissue/pulp & paper/waste samples
Method 1613B for drinking water/wastewater/soil/sediment/tissue/pulp & paper
Method T09A for ambient air sample
Method 1668A for air/soil/sediment/water/tissue/pulp & paper/waste samples
Method 8280A for soil/water
Method 1614 for drinking water/wastewater/soil/sediment/tissue

5.9. Work Cells

The dioxin department works under the work cell model. A work cell is defined as all those individuals who see a sample through the complete process if preparation, extraction and analysis. Each member of the work cell must demonstrate capability in his/her area of responsibility. Section 4.2.3 of the QA Manual describes demonstrations of capability.

5.10. Data Reduction

All calculations are performed using validated computer programs. A summary datasheet for each analysis shows the analyte concentrations, detection/reporting limits, percent recoveries of the surrogate compounds, and other relevant information. During the initial review process, data is entered into the LIMS automatically. The LIMS is programmed for generation of laboratory data reports. Any manual edits to this data required by data review are re-verified by experienced staff that is independent of the data entry functions. This step and any required editing is performed prior to generation of the final draft of the laboratory report. Data involving manual integrations is peer reviewed and senior staff reviewed.

5.11. Data Review

Data is reviewed throughout the laboratory operations processes. It is the responsibility of the login technician to verify the accuracy of the data entry into the LIMS, and the information between the sample containers and the chain-of-custody. The Project Manager then reviews the summary login sheet to the chain-of-custody verifying the project information. Preparation batch documentation generated by the lab is submitted for review. Once data is generated, it is the responsibility of the analysts to review the raw data and verify that all QC has passed. Forms are then generated from the raw data and initially reviewed by a Senior Chemist before being sent to the Data Reviewer for secondary review. The client and laboratory information contained in the sample summary datasheet originates directly from the LIMS. The use of data review checklists ensures consistency and completeness (i.e. Document #: MI27). The Project manager reviews the data deliverables prior to shipment. The final review may be completed by the PM, Technical Director, or QA Manager prior to delivery.

Guidelines for data review and qualification are derived from a variety of sources including:

- the official reference method,
- EPA documents such as "National Functional Guidelines for Organic Data Review" (US EPA, 2/94),

- "National Functional Guidelines for Inorganic Data Review" (US EPA, 2/94),
- and/or a project specific Quality Assurance Plan or Statement of Work.

Electronic Data Deliverables (EDDs) are generated by laboratory personnel. Electronic files are reviewed by staff or project manager before being sent to the client (by mail, or electronically).

5.11.1. Qualification of Data

The following flags or qualifiers are used to indicate to the user that extra consideration should be given to the results report for a particular analyte. Corrective action is taken to minimize the qualification of data. However, in some cases, qualification is still necessary.

5.11.1.1. List of Qualifiers/Flags

B – Compound also detected in Batch blank.
BQL – Below Quantification Limit
D – Detected, but RPD is >40% between results in dual column method.
E – Estimated concentration exceeds calibration range.
J – Estimated concentration, below calibration range and above MDL.

5.11.1.2. List of Ultratrace Qualifiers

B - Analyte was detected in the Lab Method Blank at a level above the Reporting Limit.
EDL - "Estimated Detection Limit".
EMPC - "Estimated Maximum Possible Concentration".
V - Recovery is below quality control limit. The data has been validated based on a favorable signal-to-noise and detection limit.
- Value is outside quality control limits.

The following flags warn the data user of situations where the uncertainty may be greater than stated average uncertainty of the method.
A - Amount detected is less than the Lower Calibration Limit.
E - Amount detected is greater than the Upper Calibration Limit.
S - The amount of analyte present has saturated the detector. This situation results in an underestimation of the affected analyte(s).
Q - Indicates the presence of a quantitative interference. This situation generally results in an underestimation of the affected analyte(s).
I - Indicates the presence of a qualitative interference that could cause a false positive or an overestimation of the affected analyte(s).
DPE - Indicates the presence of a peak in the polychlorinated diphenylether channel that could cause a false positive or an overestimation of the affected analyte(s).

5.11.2. Laboratory Software Validation

Each laboratory department is responsible for the validity of the data produced by instrumentation software. Validation responsibilities lie with the Senior Chemists who work with computer support staff and data review. Raw data produced by the instrumentation must be sufficient for completely reproducing the calculations performed by instrument software.

The validity of software used for data conversion is the responsibility of the user who compares the raw data input to the software's output. Errors are reported to the computer support staff and corrected. Changes made to the software are tracked inside the code using the initials of the person performing the modification, the date, and a version number.

Example calculations are documented in Method SOPs and at least one example calculation is written on the raw data submitted to the client.

5.12. Record Keeping

All paperwork received with samples is stored in a project folder. Bench sheets for sample preparation (extraction, digestion, and analysis by wet chemistry) are maintained in dedicated logbooks. Chromatographic data records include instrument logs, instrument tune reports, quantification reports and instrument printouts, including chromatograms and mass spectra. Inorganic data documentation records

include analyst notebooks, digestion logs, instrument run logs and instrument printouts. All logbooks have numbered pages.

Logbooks include:

- Temperature Logbook: Refrigerator, freezer, and oven temperature is recorded daily. Each unit has a NIST traceable thermometer. The temperature is recorded to ensure proper operating temperature is being utilized.
- Balance Calibration Logbook: Prior to daily use and following malfunctions, balances are checked with three S-class weights and the results compared to tolerance limits. If recalibration is required, the manufacturer's recommendations are followed.
- Standard Preparation Logbook: Records of the preparation of calibration and quality control standards are maintained. Each entry is reviewed by the department supervisor who then signs the page. Each stock, intermediate, and working standard has a unique number, which references the logbook and provides traceability. Recorded information includes manufacturer, manufacturer lot number, description of standard, date received, date opened, expiration date, and analyst. If the standard is not used as received, the lot numbers of the solvents, reagents, etc. used in the preparation of the (working) standard are recorded as well as the steps taken (dilution volumes, addition of matrix modifiers, etc) to produce the new standard.
- Supply Preparation Logbook: Each supply produced in the lab is recorded in this logbook and assigned a unique lot number. Recorded information is similar to the standard preparation logbook.
- Sample Preparation Logbook: These logbooks include documentation for each step in the preparation process. There are digestion logbooks, extraction logbooks, cleanup logbooks, injection preparation logbooks, etc. The date/time of each step (can be a beginning and ending time), the analyst, the spike witness, the standard lot number as well as the lot numbers of any reagents, solvents, and media used.
- Instrument Maintenance Logbooks: Daily operation notes, problems, routine and preventative maintenance procedures, and repairs are recorded.
- Instrument Run Logs: Records of QC and client sample analysis is recorded. These data include batch ID, instrument ID, method, filename, sample ID, analysis date/time, lot numbers of standards, injection volume, and analyst initials. The unused portion of the daily run log page is crossed out and initialed.

5.13. Data Package Assembly

SGS offers multiple standard reporting formats. A summary data package consists of a cover letter (including the case narrative) and all sample results. A summary plus QC data package consists of a summary data package plus QC results. A full data package includes copies of all laboratory raw data used for the sample and QC data. SGS can also include a signed affidavit with report when required (i.e. Ohio VAP). Electronic deliverables are also available including the original hardcopy in a pdf format and various types of EDD file formats. Employees of this lab who are approved for signing of final reports are:

- Kendall Sutler
- Mike Larkins
- Jeannie Milholland
- Chris Cornwell
- Greg Dickinson
- Erin Staggard
- Lori Lockamy

5.14. Shipping

Upon final review the lab report is faxed to the client and sent to the invoicing department. An invoice is generated and the final report and invoice are then mailed to the client using the US Postal Service. Reports can be sent via an express carrier if needed. Electronic deliverables are also available.

5.15. Archiving

Hard copies of the reports are kept on site one year before being transferred to a long-term storage facility separated from the lab by a fire rated wall where they will remain for no more than five years unless special arrangements are made at the onset of the project. Electronic raw data are duplicated and archived for a period of 10 years. One electronic copy remains on site while the duplicate is sent to an off-site long-term archive location.

In the event SGS transfers ownership or goes out of business all clients will be contacted regarding laboratory records. SGS will follow individual client instructions on how the laboratory data will be transferred.

5.16. Procedures for Preserving Confidentiality during Electronic Transmission of Test Results

SGS has a plan that covers all computers and information systems located at the Wilmington, NC facility (document MI12). Preventative security systems include an Internet Firewall, the use of Encryption, and Power protection/maintenance. Procedures are in place to detect electronic intrusion, viruses, and limit access to critical data internally. See the Cyber Security Plan, Document #MI12 for more information.

6. Departure from Standard Policy or Procedure

No set of laboratory policies and procedures will apply to all environmental samples due to the high degree of variability inherent in these matrices. Therefore, it will sometimes be necessary to depart from documented procedures in order to ensure validity of data or to meet client requirements.

When it is determined that a departure from documented policies and procedures may be required, a discussion of the situation is held by the Project Manager with the client before beginning or continuing with the analysis of the affected sample(s).

If a departure is deemed necessary, the laboratory staff will determine and document the actions to be taken, the reason for the departure from protocol, and any potential effects on the data. This is to be submitted to the Technical Director and/or the client. Once the course of action is determined and all necessary approvals obtained, analysis may continue. The documentation will be placed in the project folder and archived with the project records. The procedure will be discussed in the case narrative, and a copy of the documentation will be included in the final report to the client.

If it is determined that the departure is to become a routine part of an analysis, revised SOPs must be issued and submitted for approval to the QA Manager. Some certifying bodies also require revised SOPs to be forwarded to them for approval prior to use on their samples.

7. Complaint Resolution

Complaints involving the quality of data or reports produced by SGS are to be investigated and resolved. The procedures to be followed upon receipt of such complaints, including documentation of the complaint and its resolution are as follows:

Any employee receiving a complaint regarding data and /or report quality shall initiate a Complaint Resolution Form (CRF, Figure 7). The employee will include the name of the client, the affected project, and a description of the complaint. The employee shall then notify the Project Manager of the complaint, and an investigation will be conducted. The Project Manager, the General Manager or a designee may conduct the investigation. The individual performing the investigation will retain the CRF until the complaint is resolved with the client. At this point, the investigation will be considered concluded and the resolution will be described on the CRF. One copy of the completed CRF will be placed with the project records and a second copy will be provided to the general manager. The quality assurance manager will maintain a file of all completed CRF's.

8. Quality Assurance Reports and Planning

The following completed reports are filed with the Quality Assurance Manager:

- Corrective Action
- Complaint Resolution
- SOP Deviation

The QAM issues a report to Management following each Performance Evaluation, Internal and External Audit.

9. Facilities

Facility and Equipment

SGS is housed in a single story building of 26,940 square feet. The Ultra-Trace Analyses section occupies approximately 8000 square feet. All critical instrumentation are connected to an uninterrupted power supply (UPS). Access to the facilities is controlled at all times. All visitors are required to sign in at the receptionist desk and are escorted by laboratory personnel while in the building. An electronic system secures the building during the non-working hours. A punch lock is installed on doors that are not locked at all times.

Accomodations and environmental conditions are controlled and monitored within the facility at all times. Instrumentation are located a proper distance from electrical supply, and a proper distance from each other, so as to avoid electromagnetic disturbances. Air temperature is maintained with designated thermostats in each laboratory area. Samples are protected from light when indicated by the test method.

Contract personnel are maintained to ensure good housekeeping in the office areas of the building. Technicians and analysts are responsible for the housekeeping in their respective lab workspaces.

A list of relevant instrumentation is listed in Figure 8.

10. Glossary

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Aliquot: A discrete, measured, representative portion of a sample taken for analysis. (EPA QAD)

Analysis Duplicate: The second measurement of the target analyte(s) performed on a single sample or sample preparation.

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Analyte: The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together. (DoD)

Audit: A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA QAD)

Batch: Environmental samples, which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch (work group) is composed of one to 20 environmental samples of the same matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. A QC batch is composed of one to 20 environmental samples of the same matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last work group in the batch to be 30 days. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and/or those samples not requiring preparation, which are analyzed together

as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples.

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Blind Sample: A subsample for analysis with a composition known to the submitter. The analyst/ laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibrate: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration: The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring device, or the correct value of each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response. (NELAC)

Calibration Method: A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard: A substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO 30)

Chain of Custody (COC): An unbroken trail of accountability that ensures the physical security of samples, and includes the signatures of all who handled the samples from sampling to receipt by the laboratory. An Internal Chain of Custody (ICOC) is a similar document used by the laboratory to track each sample from receipt to disposal.

Chemical: Any element, compound, or mixture of elements and/or compounds. Frequently, chemical substances are classified by the CAS rules of nomenclature for the purposes of identification for a hazard evaluation. (DoD)

Client: The party that has agreed to pay the bill for services rendered by the laboratory, and with whom the laboratory has a contractual relationship for that project. This is typically the prime contractor who originally hires the laboratory for the project, and who signs the contract as the receiver of services and resulting data.

Compound: A unique combination of chemical elements, existing in combination to form a single chemical entity. (DoD)

Component: A single chemical entity, such as an element or compound. Multiple components may compose one analyte. (DoD)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions,

compromised samples are not analyzed. If emergency situations require analysis, the results must be appropriately qualified. (NELAC)

Confirmation: Verification of the presence/identity of a component that may include second column analysis.

Controls: Negative: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. Positive: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Corrective Action: Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 30)

Corrective Action Report (CAR): Documentation created during a corrective action investigation.

Data Reduction: The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collating into a more useful form. (EPA QAD)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate acceptable accuracy. (NELAC)

Detection Limit: The lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. See Method Detection Limit, Quantitation Limit, and Limit of Detection. (NELAC)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Duplicate: Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA QAD) Laboratory: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

EDD: Electronic Deliverable Data

Holding Times: The time elapsed from the time of sampling to the time of extraction or from extraction to analysis, as appropriate. A Maximum Allowable Holding Time is time that a sample may be held prior to extraction/analysis and still be considered valid.

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. (NELAC)

Instrument Blank: A clean sample (e.g., solvent) processed through the instrumental steps of the measurement process; used to determine instrument contamination.

Definitive Data: Data that are generated using rigorous analytical methods, such as approved EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data in the form of paper printouts or electronic files. Data shall satisfy QA/QC requirements. For data to be definitive, either analytical or total measurement error shall be determined and documented. (DoD)

Laboratory: A body that calibrates and/or tests. In cases where a laboratory forms part of an organization that carries out other activities besides calibration and testing, the term "laboratory" refers only to those parts of that organization that are involved in the calibration and testing process. As used herein, the term "laboratory" refers to a body that carries out calibration or testing at or from a permanent location, from a temporary facility, or a mobile facility. (DoD)

Laboratory Control Sample (LCS) (however named, such as ongoing precision and recovery sample(OPR), laboratory fortified blank, spiked blank, etc.): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC).

Limit of Detection (LOD): The lowest concentration level that can be determined by a single analysis and with a defined level of confidence to be statistically different from a blank. See also Method Detection Limit, Detection Limit, and Quantitation Limit (DoD)

Matrix: The component or substrate that may contain the analyte of interest. For purposes of batch determination, the following matrix types shall be used:

- Aqueous: Any aqueous sample excluded from the definition of a drinking water matrix or saline/estuarine source including surface water, groundwater and effluents.
- Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
- Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.
- Non-aqueous Liquid: Any organic liquid with <15% settleable solids.
- Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.
- Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.
- Air: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter or other device.

Key Staff: At a minimum, the following managerial and supervisory staff (however named) – executive staff (for example, Chief Executive Officer, Chief Operating Officer, laboratory director, technical director); technical directors/supervisors (for example, section supervisors for organics and inorganics); quality assurance systems directors/supervisors (for example, QA officer, quality auditors); and support systems directors/supervisors (for example, information systems supervisor, purchasing director, project manager).

Matrix Spike (spiked sample, fortified sample): Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Matrix Spike Duplicate (spiked sample/fortified sample duplicate): A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) in which no target analytes or interferences are present at concentrations that impact the analytical results. It is processed simultaneously with samples of similar matrix and under the same conditions as the samples. (NELAC)

Method Detection Limit (MDL): The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Nonconformance: An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and or biological integrity of the sample. (NELAC)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA QAD)

Pure Reagent Water: Shall be water (defined by national or international standard) in which no target analytes or interferences are detected as required by the analytical method. (NELAC)

Quality Assurance: An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Control: The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample: An uncontaminated sample matrix with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA QAD)

Quality Manual (however named, Quality Assurance Plan or Quality Plan, etc): .A document stating the quality policy, quality system and quality practices of an organization. The quality manual may call up other documentation relating to the laboratory's quality arrangements. OR A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA QAD)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI)

Quantitation Limits: The maximum or minimum levels, concentrations, or quantities of a target that can be quantified with the accuracy required by the intended use of the data user. (NELAC) OR The value at which an instrument can accurately measure an analyte at a specific concentration (i.e., a specific numeric concentration can be quantified). These points are established by the upper and lower limits of the calibration range. (DoD)

Range: The difference between the minimum and the maximum of a set of values. (EPA QAD)

Raw Data: Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA QAD)

Reagent Blank (method reagent blank): A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions. (EPA QAD)

Reference Material: A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO 30)

Reference Method: A method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard: A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (DoD)

Replicate Analyses: The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit: A specific concentration at or above the lower quantitation limit that is reported to the client with confidence. It is often defined on a project-specific basis. If set by the client below the lower quantitation limit, method modification is required or the client will be required to accept the lowest technically valid value that can be provided by the laboratory. For methods that require only one standard (for example, lower limit of calibration curve is the origin), the reporting limit shall be no lower than the low-level check standard.

Sample – Portion of material collected for chemical analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analyses.

Sampling Media: Material used to collect and concentrate the target analyte(s) during air sampling such as solid sorbents, filters, or impinger solutions.

Selectivity: (Analytical chemistry) The capability of a test method or instrument to respond to a target substance or constituent in the presence of nontarget substances.

Sensitivity: The capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Spike: A known mass of target analyte added to a blank, sample or subsample; used to determine recovery efficiency or for other quality control purposes.

Standard Operating Procedure (SOP): A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standard Reference Material (SRM): A certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA QAD)

Technical Director (however named): Has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test: A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (DoD)

Test Method: An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Test Sensitivity/Power: The minimum significant difference (MSD) between the control and test concentration that is statistically significant. It is dependent on the number of replicates per concentration, the selected significance level, and the type of statistical analysis. (NELAC)

Traceability: The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (DoD)

Validation: The process of substantiating specified performance criteria. (EPA QAD)

Verification: Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC) Verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustments, or to repair, or to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Work Cell: A well-defined group of analysts that together perform the method analysis. The members of the group and their specific function/s within the work cell must be fully documented. (NELAC)

Sources:

ANSI = American National Standards Institute (ANSI), Style Manual for Preparation of Proposed American National Standards, Eighth Edition, March 1991

ASQC = American Society for Quality Control (ASQC), Definitions of Environmental Quality Assurance Terms, 1996

DoD = Department of Defense Quality Systems Manual for Environmental Laboratories Based on NELAP– Version 1

EPA QAD = U.S. EPA Quality Assurance Division

ISO 30 = International Standards Organization (ISO) Guides 2, 30, 8402

NELAC = National Environmental Laboratory Accreditation Conference, 2003 Standards

QAMS = U.S. EPA Quality Assurance Management Section (QAMS), Glossary of Terms of Quality AssuranceTerms, 8/31/92 and 12/6/95

11. References

Department of Defense Quality Systems Manual for Environmental Laboratories. Version 3. January 2006.

Figure 1. Initial Precision and Accuracy Study Performance Criteria Summary

Analytical Method	Analytes Accuracy (%Recovery)	Precision (%RSD)
1030 Ignitability	50-150	30
1311 TCLP	See footnote 1	
150.1 pH	See footnote 2	
300.0 Nitrite	90-110	20
300.0 Orthophosphate	90-110	20
300.0 Nitrate	90-110	20
504.1 Volatiles	70-130	20
601 Volatiles	See footnote 3	
6010 ICP Metals	80-120	20
602 Volatiles	See footnote 3	
6020 ICPMS Metals	80-120	20
624 Volatiles	See footnote 3	
625 Semi-volatiles	See footnote 4	
7196 Chromium VI	See footnote 2	
7471 Mercury	85-115	20
8011 Volatiles	70-130	20
8015 DRO	70-130	20
8015 GRO	70-130	20
8015 Methanol	70-130	20
8021 Volatiles	70-130	20
8081 Pesticides	70-130	30
8082 Aroclors	70-130	30
8151 Herbicides	70-130	20
8260 Volatiles	70-130	20
8270 Semi-volatiles	See footnote 4	20
8310 PAHs	70-130	20
8315 Extractable Organics	70-130	20
9045 pH	See footnote 2	20
MA-EPH Extractable Organics	40-140	40
MA-VPH Volatile Organics	70-130	25
SM 6230D	70-130	20

[1] Requires 4 practice samples with success defined by trainer.

[2] Requires successful PE analysis.

[3] Requirements found in method.

[4] Limits derived from LCS results.

Figure 1. (Continued) Initial Precision and Accuracy Study Performance Criteria Summary

Analytical Method	Analytes		Extraction Stds		Cleanup/Sampling Stds	
	Accuracy (%Rec.)	Precision (%RSD)	Accuracy (%Rec.)	Precision (%RSD)	Accuracy (%Rec.)	Precision (%RSD)
1613	See Method.					
8290	±30[1]	20[2]	40-135	20[2]	70-130	20[2]
23	±30[3]	20[3]	40-135(Cl_4-Cl_6) 25-130(Cl_7-Cl_8)	20[3]	70-130	20[3]
TO-9A	±30[3]	30[4]	50-120(Cl_4-Cl_6) 40-120(Cl_7-Cl_8)	30[4]	70-130	30[4]
8280	±30[3]	20[3]	25-150	20[3]	70-130	20[3]
1668A	60-140	40	35-135	50	45-120	45

[1]Limit taken from method 8000.

[2]Analogous limit: taken from 8.3.6.4, MS/MSD requirement.

[3]Adopted limit.

[4]Analogous limit: taken from 15.9, duplicate requirement.

Figure 2: Sample acceptance policy DC135.090803.1

Sample Acceptance Policy

(Provided per NELAC requirements by SGS Environmental Services)

Summary: Samples received by the laboratory must meet certain criteria in order for the associated analytical data to meet method criteria. Samples must be properly documented and shipped in appropriate containers at specified temperatures. Holding times must be met and the amount of sample provided must be sufficient for the required extraction procedures.

Procedure: The validity and defensibility of analytical data is highly dependent upon proper delivery of samples to the laboratory. It may be impossible for the laboratory to perform the required analyses if samples are not properly documented and shipped in a timely fashion using appropriate containers and shipping materials. The following criteria are used to evaluate the suitability of samples prior to their acceptance for analysis:

a) Documentation: All samples must be accompanied by chain-of-custody forms indicating unique sample identification, date and time of sampling, location of collection, collector's name, any preservatives used, sample type (e.g. soil, water, etc.), requested analyses and any special remarks concerning the samples.
b) Chain-of-custody forms must accompany the samples and cannot be sent separately.
c) Sample Labeling: Each sample must be given a unique identifier that allows for cross-referencing with the chain-of-custody information. Sample labels must be durable enough to remain attached to the containers and utilize indelible ink to remain legible during shipping.
d) Sample Containers: Samples must be shipped in containers appropriate for the required analyses. Liquid and solid samples collected for organics analyses should be shipped in glass containers. Other matrices may require special containers (e.g. air samples). Any questions regarding sample containers must be resolved prior to collecting the samples. Containers should be packaged in such a way as to preclude breakage or leaking during shipping.
e) Damage: Samples should be inspected for signs of damage. *Discrepancy Procedure: Damaged containers must be safely repackaged and quarantined. Record the damage found and action taken. Report container damage to client services.*
f) Contamination: The shipment should be inspected for signs of contamination. Discrepancy Procedure: Safely separate the samples and remove any further means of contamination. Record the condition of the samples and action taken. Report potential contamination to client services.
g) Preservation: It is generally required that samples be chilled to < 4° C and kept at that temperature during shipping. Therefore, samples should be placed in insulated coolers with ice to keep them at or near this temperature until delivery at the laboratory. Samples that arrive above 6°C and are not on ice will be rejected and the client will be contacted for further instructions, such as re-sampling if for compliance monitoring. *Discrepancy Procedure: Inadequate preservation must be reported to client services.*
h) Holding Times: In order to provide accurate, defensible data, analytical methods strictly limit the amount of time that may elapse between collection and extraction of samples. Data taken from the analysis of samples which have exceeded the required holding times is generally considered to be invalid and is not legally defensible. Therefore, it is imperative that samples be sent to the laboratory as quickly as possible after collection. Ideally, the samples will be sent via overnight courier on the same day as collection. When this is not possible, the samples must arrive at the laboratory with enough time left to allow for proper login procedures before the holding time elapses. Samples received with few days left in the holding time may not be accepted by the laboratory.
i) Sample Volume: Sufficient sample volume must be sent for all required tests. Each method specifies the required sample volume for each applicable matrix. Questions regarding required sample volumes must be resolved prior to sampling.
j) Client Notification: When sample login is completed, a summary of the samples received and entered into the LIMS is generated. This can be faxed to the client upon request. This fax will include client sample ids, lab ids, dates, analyses requested and status summaries in short form.

The laboratory will attempt to contact the client and resolve any issues with sample acceptance. Samples that are immediately rejected are ones with improper preservation, damage, or show signs of contamination. In other cases, it may be possible to continue with analysis, although the analysis may be compromised. For instance, samples received with insufficient volume may be analyzed with the resulting data reflecting increased detection limits due to the insufficient volume, and minor discrepancies in sample documentation may be easily resolved. In such cases, the Technical Director/Project Manager will contact the client and describe the problem and any potential effects on the data. The client may then determine if the resulting data is likely to meet their needs. In other instances (e.g. samples received without labels or in broken containers), it may be impossible for the lab to proceed with analysis. In all cases, the Technical Director/Project Manager will make the final decision regarding the laboratory's acceptance of samples.

Figure 3. Example Chain-of-Custody Record

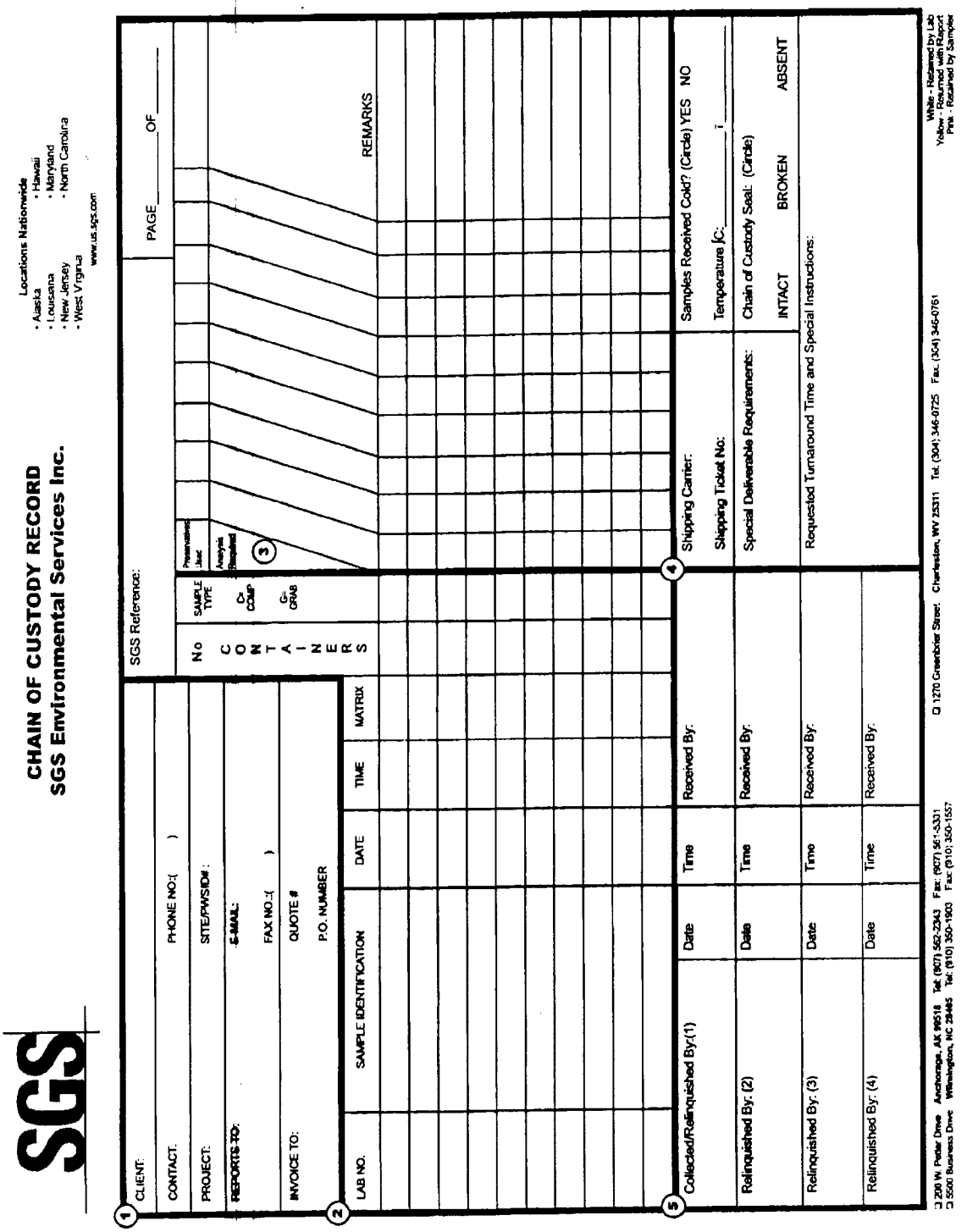


Figure 4: Sample Receipt Checklist

Sample Receipt Checklist (SRC)

SGS Environmental Services

Client: **Client Company Name** Lab Proj. ID: **G671-41**

Client Proj. ID: **Client Project ID**

1. __ Shipped
   X Hand Delivered
   Notes:

2. X Proper, full, and complete documentation
   (unique sample identification on durable label with indelible ink, location of collection, date/time of collection, collector's name, preservation type, sample type (method/matrix))
   __ Acceptable documentation (but, incomplete)
   __ Unacceptable documentation
   Notes:

3. __ Custody Tape on Container
   X No Custody Tape
   Notes:

4. X Samples Intact*
   (are in appropriate container, are not damaged, and do not show signs of contamination)
   __ Samples Broken / Leaking
   __ VOA Vials Checked for Air Bubbles
   Notes:

5. X Chilled on Receipt* Actual Temp.(s) in °C: 5.8
   __ Ambient on Receipt
   __ Walk-in on Ice; Coming down to temp.
   __ Received out of temperature protocol
   Notes:

6. X Sufficient Sample Submitted
   __ Insufficient Sample Submitted
   Notes:

7. X Samples Preserved Correctly*
   (see preservative checklist where applicable)
   __ Improper Preservative(s)
   __ None recommended (N/A)
   Notes:

8. X Received Within Holding Time
   __ Not Received Within Holding Time
   __ N/A
   Notes:

9. X No Discrepancies Noted
   __ Discrepancies Noted
   Notes:

Comments:

* = Rejection of sample is required when not marked; Contact client services immediately for a resolution.

Inspected and Logged in by:

DC27.040307.4 Date / Time: Tue-4/3/07 15:25

Figure 5: Table of Holding Times

Method	Matrix	Extraction Holding Times	Analysis Holding Times	Container	Preservation
Volatiles - 601, 602, 624, 8021, 8260, 6230D	Aqueous/Solid	NA	14 Days from Collection	3x40mL Voa Vials/1x4oz. Jar/5035 MeOH	A: HCl, 0-4°C[2] S: 0-4°C
Semivolatiles - 8270, 625, 610, 8310	Aqueous/Solid	A: 7 Days S: 14 Days from Collection	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	0-4°C[2]
MA-EPH Extractable Organics	Aqueous/Solid	14 Days	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	A: HCl, 0-4°C S: 0-4°C
MA-VPH Volatile Organics	Aqueous/Solid	14 Days	14 Days from Collection	2x40mL Voa Vials/1x4oz. AGJ	A: HCl, 0-4°C S: 0-4°C
8081 Pesticides	Aqueous/Solid	A: 7 Days S: 14 Days from Collection	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	0-4°C[2]
8082 Arochlors	Aqueous/Solid	A: 7 Days S: 14 Days from Collection	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	0-4°C[2]
8151 Herbicides	Aqueous/Solid	A: 7 Days S: 14 Days from Collection	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	0-4°C[2]
300.0 Total Nitrate-Nitrite	Aqueous	NA	28 Days from Collection	1x125mL Plastic	H_2SO_4
504.1/8011 Volatiles	Aqueous/Solid	14 Days from Collection	24 Hours from Extraction	3x40mL Voa Vials	0-4°C[2]
6010 ICP Metals	Aqueous/Solid	NA	6 Months from Collection	1x125mL Plastic	A: HNO_3
6020 ICPMS Metals	Aqueous/Solid	NA	6 Months from Collection	1x125mL Plastic	A: HNO_3
300.0 Nitrite	Aqueous	NA	48 Hours from Collection	1x125mL Plastic	
300.0 Orthophosphate	Aqueous	NA	48 Hours from Collection	1x125mL Plastic	
7470/7471 Mercury	Aqueous/Solid	NA	28 Days from Collection	1x500mL Plastic	A: HNO_3
8015 DRO	Aqueous/Solid	A: 7 Days S: 14 Days from Collection	40 Days from Extraction	1x1L AGB/1x4oz. AGJ	A: HCl, 0-4°C S: 0-4°C
8015 GRO	Aqueous/Solid	NA	14 Days from Collection	2x40mL Voa Vials/1x4oz. Jar	A: HCl, 0-4°C S: 0-4°C
1030 Ignitability	Aqueous/Solid	NA	ASAP after removal from container		
1311 TCLP	Solid	14 Days from Collection	See Determinative Method.	See Determinative Method.	None.

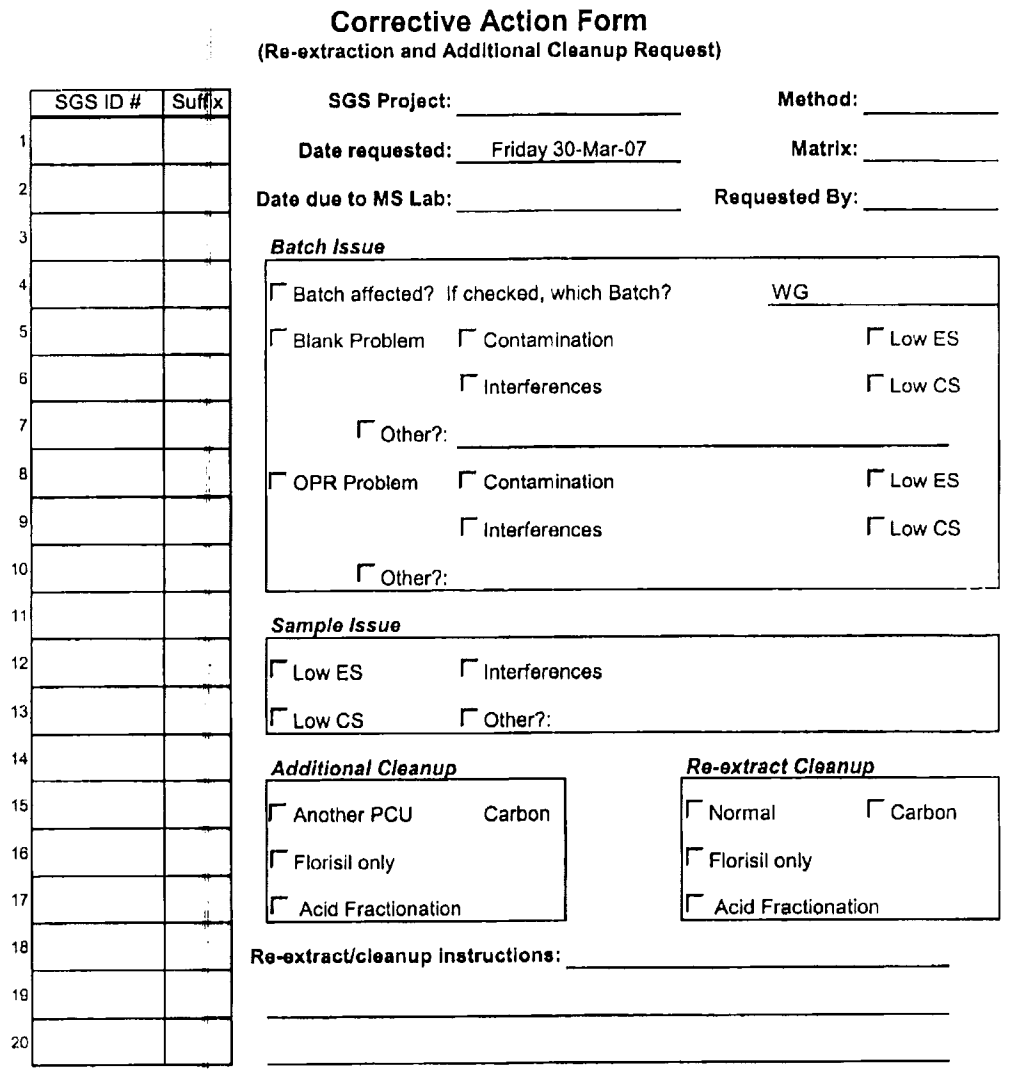
Figure 5: (continued) Table of Holding Times

Method	Matrix	Extraction Holding Times	Analysis Holding Times	Container	Preservation
7196 Chromium VI	Aqueous/Solid	S: 1 month from Collection	A: 24 Hours from Collection S: 4 days from Digestion	1x500mL Plastic /1x4oz. Jar	0-4°C
8015 Methanol	Aqueous/Solid	NA	14 Days from Collection	2x40mL Voa Vials	A: HCl, 0-4°C
8315 Extractable Organics	Aqueous/Solid	A: 3 Days S:ASAP from Collection	3 Days from Extraction	1x1L AGB/1x4oz. AGJ	0-4°C
SM4500H+, 9045 pH	Aqueous/Solid	NA	15 Minutes from Collection	1x125mL Plastic/1x4oz. Jar	
8280	Aqueous/Solid	30 days	45 Days from Extraction	Amber Glass Bottle/Jar[1]	4°C
8290	Aqueous/Solid Tissue	30 Days	45 Days from Extraction	AGB/AGJ[1]	4°C (T: -20C), Dark
1613	Aqueous/Solid Tissue	1 Year	45 Days from Extraction	AGB/AGJ[1]	A: 0-4°C[2] S/T: <-10°C
23	MM5 Train	30 Days	45 Days from Extraction	Train/AGB	0-4°C; Dark
TO9	PUF	7 Days	40 Days from Extraction	Aluminum Foil	<4°C
1668	Aqueous/Solid	1 Year	1 Year from Extraction	AGB/AGJ[1]	A/S: 0-4°C[2] T: <-10°C

[1]Mimimun Sample Amount: Aqueous, 1L; Solid, 100g; Tissue, 100g.

[2]If residual chlorine is present in aqueous samples; add 80 mg sodium thiosulfate per liter of water.

Figure 6: Example Routine Corrective Action Form



Corrective Action Form

(Re-extraction and Additional Cleanup Request)

	SGS ID #	Suffix
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

SGS Project: _____ **Method:** _____

Date requested: Friday 30-Mar-07 **Matrix:** _____

Date due to MS Lab: _____ **Requested By:** _____

Batch Issue

☐ Batch affected? If checked, which Batch? WG

☐ Blank Problem ☐ Contamination ☐ Low ES

☐ Interferences ☐ Low CS

☐ Other?: _____

☐ OPR Problem ☐ Contamination ☐ Low ES

☐ Interferences ☐ Low CS

☐ Other?:

Sample Issue

☐ Low ES ☐ Interferences

☐ Low CS ☐ Other?:

Additional Cleanup

☐ Another PCU Carbon

☐ Florisil only

☐ Acid Fractionation

Re-extract Cleanup

☐ Normal ☐ Carbon

☐ Florisil only

☐ Acid Fractionation

Re-extract/cleanup instructions: _____

Note:
Samples that receive a re-extract or additional cleanup need a suffix to distinguish them from the original. This suffix will be assigned in the LIMS. This form should be kept in the project folder.

DC18.033007.5

Figure 7: Complaint Resolution Form

SGS Environmental Services

Complaint Resolution Form

Initiated by:
Date:

Client Name:
Project Number:

Description of Complaint:

Corrective Action Taken (if necessary):

Resolution:

Investigated by:
Date Completed:

1 copy to be filed with project records
1 copy to Laboratory Director

DC32.033007.2

Figure 8: Equipment Lists

			Instrument	Manufacturer	Model	Units
W & S	SVOA	Analytical	Gas Chromatograph	Agilent	6890	3
			Gas Chromatograph	Hewlett Packard	5890	3
			Quadrople Mass Spectrometer	Agilent	5973	1
			Quadrople Mass Spectrometer	Agilent	5973N	1
			Electron Capture Detectors	Hewlett Packard		4
			Flame Ionization Detectors	Hewlett Packard		2
			Autosamplers	Hewlett Packard	7673	5
			Autosamplers	Agilent	7683	2
			Large Volume Injection Unit	Apex	Prosep 800	2
			Liquid Chromatograph System (HPLC)	Hewlett Packard	1100	1
			HPLC - Auto Loop Sampler	Hewlett Packard	G1313A	1
			HPLC - Manual Injection Loop	Hewlett Packard	G1328A	1
			HPLC - UV Detector	Hewlett Packard	G1314A	1
			HPLC - Fluorescence Detector	Hewlett Packard	1036A	1
			Instrument Control Computer Systems			7
			Lab Workstation Computers			2
		Extractions	Liquid / Liquid Extractor Unit		18 position	2
			Water Chiller / Recirulator	Cooling Tech.	CID010-9	1
			Water Heater Unit	Chormolox		1
			Accelerated Solvent Extractor	Dionex	ASE 200	2
			Sonicator	Tekmar		2
			Evaporator	Zymar	LV	1
			Hot Plates	Thermolyne	Ciramel 3	1
			Hot Plates	IKA	RCT	1
			Sonic Bath			1
			Nitrogen Blowdown Apparatus	Supleco		1
			Lab Workstation Computers			2
	VOA	Analytical	Gas Chromatograph	Hewlett Packard	5890	7
			Gas Chromatograph	Agilent	6890	1
			Volatile Autosamplers	Archon		8
			Purge & Trap Concentrator	Tekmar	3000,3100	5,2
			Purge & Trap Concentrator	Tekmar	Velocity	1
			Purge & Trap Concentrator	Hewlett Packard	3000	1
			Quadrople Mass Spectrometer	Hewlett Packard	5972	4
			Electrolytic Conductivity Detectors	O.I. Analytical	5220,5320	1,2
			Photoionization Detector	O.I. Analytical	52,304,430	1,3
			Instrument Control Computer Systems			8
W & S	Metals	Analytical	ICP	Perkin Elmer	Optima 3000XL	1
			ICP Autosampler	Perkin Elmer	AS 90/91	1
			ICP-MS	Perkin Elmer	ELAN 6000	1
			ICP-MS Autosampler	Perkin Elmer	AS 93+	1
			Spectrophotometer	Milton Roy	Spectonic 21D	1
			Mercury Analyzer	Perkin Elmer	FIAS 100	1
			Mercury Analyzer - Autosampler	Perkin Elmer	AS 90/91	1
			Ion Chromatograph (IC)	Dionex	DX-500	1
			IC - Autosampler	Dionex	AS-40	1
			Water Chiller / Recirulator	VWR	CFT-75	1
			Instrument Control Computer Systems			4
		Digestion	Microwave Digestion Unit	Milestone		1
			Hot Block	Env. Express	54 Place	1
			Auto Block	Env. Express	54 Place	1
			Hot Plate	Thermolyne	Cimarel 3	1
			Hot Plate	Fisher		1
	Misc.	LAB	Balance	Mettler	B3002	1
			Balance	Denver Instruments	XE-510	2
			Balance	Denver Instruments	A-160	1
			Oven	Fisher		1
			Muffle Furnace	Wilt Industries	200S	1
			Water Purification System	Barnstead		1
			pH Meter	Orion	320	1
		Office / Productivity	Office Computers			9
			Office Printers			4
			Fax			2
			Copier			2
			Scanner			1
		Building	UPS System	Exide Electronics		1
			Diesel Generator	Catapillar		1

Figure 8: continued: Equipment dedicated to the Ultratrace Lab

		Instrument	Manufacturer	Model	Units
Dioxins	Analytical	Gas Chromatograph	Agilent	6890	4
		Double-Focusing Mass Spectrometer	MicroMass/Waters	AutoSpec Ultima	3
		Quadrople Mass Spectrometer	Agilent	5973	1
		Autosamplers	CTC	A200 SE	2
		Autosamplers	Agilent	7683	1
		Autosamplers	CTC	GC PAL	1
		Instrument Control Computer Systems	DEC, IBM		3
	Sample Prep	Recirculator	Neslab	CFT-75	1
		Recirculator	Neslab	CFT-300	1
		Solid Phase Extraction Manifold	PV	6 position	1
		Soxhlet Extraction Assembly	Glascol	24 position	1
		Turbovap Evaporator	Zymark	LV	1
		Giant Soxhlet Extraction System	Ace		1
		Paradigm Cleanup Assembly	PV	12 position	2
		CLLE Extraction Assembly	PV	24 position	1
		Rotary Evaporator	Buchi R		1
	Misc.	Centrifuge	Damon	IEC HN-SII	1
		Dry Vacuum System Pump	Welch	2025	1
		Vacuum Chambers	Labconco		4
		Ovens	Fisher		2
		Ovens	Wilt Industries	804	1
		Muffle Furnace	Wilt Industries	210	1
		Sonic Bath	Branson	2210	1
		Balance	Denver Instruments	XL-3100D	1
		Balance	Ohaus	Scout Pro	1
		Dessicator	Boekel		1
		Solvent Delivery System	Various		3
		Water Purification System	Dracor		1
	Office / Productivity	Lab Workstation Computers			3
		Lab Workstation Printers			3
		L.I.M.S.	Labvantage Systems		1
		Office Computers			4
		Office Printers			4
		Scanner			1
		Copier			1
	Building	UPS System	Exide Electronics		1
		Diesel Generator	Caterpillar		1